

# Factors Associated With Increased Prevalence of Diabetic Foot Ulcer and its Poor Outcome

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## ABSTRACT

**Objective:** To determine factors associated with increased prevalence of Diabetic Foot Ulcer and its poor outcome in our set up

**Study Design:** Observational / prospective study

**Place and Duration of Study:** This study was conducted at Bahawalpur Victoria Hospital, Bahawalpur from December 2015 to February 2016.

**Materials and Methods:** One hundred and one patients above the age of 18 years presenting with DFU were enrolled. Detailed history was taken regarding patient's education, type and duration of diabetes, smoking and comorbidities like hypertension and ischemic heart disease(IHD). We evaluated ulcer for duration, site, pain and depth of wound.

**Results:** Majority of patients were male(69.3%), had type 2 Diabetes(95%) and were uneducated(82.17%). Mean age was 59±10.43 years and mean duration of diabetes was 10.38±7.9 years. 32.6% patients had Hypertension, 23.7% had IHD and 24.7% were smokers. 85.1% had sensory neuropathy and 41.58% had retinopathy. PAD(18.8%) and nephropathy(7.9%) were relatively uncommon. Patients were divided into three groups based on outcome: healed(2.97%), unhealed(63.36%) and amputation(33.66%) group. Mean duration of presentation was 24±10.39 days in healed, 72.61±179.49 days in unhealed and 49.82±41.75 in amputation group. Wagner classification showed that 0% in healed, 70.31% in unhealed and 94.11% ulcers in amputation group were of grade 3 or above. Sensory neuropathy (94.11%) and smoking(29.41%) were more common and mean HbA1c(8.05±1.55) was highest in amputees.

**Conclusion:** DFU is common in old, uneducated males with long duration of Diabetes. Hypertension, IHD, neuropathy, retinopathy and smoking were common in DFU patients. PAD and nephropathy were uncommon. We observed high amputation and low healing rates. Sensory neuropathy, wagner grade (p values <0.05), poor glycemic control and smoking (p values >.05) were associated with poor outcome. Earlier presentation and aggressive treatment according ulcer grade can improve outcome of this disabling morbidity.

**Key Words:** Factors, Prevalence, Diabetic Foot Ulcer, Outcome.

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## INTRODUCTION

The prevalence of diabetes for all age groups worldwide was estimated to be 2.8% in 2000 and will be 4.4% in 2030.<sup>1</sup> The prevalence of diabetes in Pakistan is very high. According to Diabetes Prevalence Survey of Pakistan prevalence of type 2 diabetes is 16.98%.<sup>2</sup>

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as macrovascular. Diabetic foot ulcer (DFU) is a common and serious complication of diabetes and most common cause of lower extremity amputation.<sup>3</sup> It is attributable to both microvascular complication like neuropathy and macrovascular complication like peripheral arterial disease(PAD). Infection is a most common precipitating factor.

Large number of patients with DFU present in surgical departments for dressing and debridement and in medical departments for glycaemic control. Treatment of DFU is a challenge for clinicians.

Many studies have been done all over the world to find out risk factors of DFU. The purpose of this study was to find out the factors associated with increased prevalence of DFU and its poor outcome in our setup. Identification of these predictors and poor prognostic factors will have an important role to prevent this potentially disabling morbidity. Morbidity and mortality of diabetes is mostly because of its complications which can be microvascular as well.

## MATERIALS AND METHODS

This study was conducted in BV Hospital Bahawalpur from December 2015 to February 2016. One hundred and one patients above the age of 18 years presenting with DFU were enrolled. Detailed history was taken regarding patient's education, type and duration of diabetes, smoking and comorbidities like hypertension and ischemic heart disease(IHD). We evaluated ulcer for duration, site, pain and depth of wound. Wagner classification was used to grade ulcer. Detailed CNS examination was done to see evidence of sensory, motor and autonomic neuropathy and retinopathy. Palpation of peripheral pulses and doppler flow study was done for PAD. Routine investigations done included complete blood and urine examination, fasting and random blood glucose, glycated haemoglobin (HbA1c) and renal parameters.

Patients were classified into three groups to identify the factors associated with poor outcome: first group included patients with healed ulcer, second group of patients with unhealed ulcer but without need for

amputation and third group with a minor or major amputation.

Statistical Package for Social Sciences(SPSS) version 20 was used for statistical analysis of data. Descriptive analysis was applied to calculate frequency and percentage for qualitative variables. Mean and standard deviation was calculated for quantitative variables. Chi square test was used to analyse variables in three groups. P value of <0.05 was considered significant.

## RESULTS

Out of 101 patients, 70(69.3%) were males. Mean age was 59.04±10.432(22-82) years, 96(95%) had type 2 Diabetes and 83(82.17%) patients were uneducated. Mean duration of DM was 10.38±7.9(0.03-30) years. Thirty three patients(32.67%) had hypertension, 24 (23.76%) had IHD, 25(24.7%) were smokers. Eighty six(85.1%) had sensory, 27(26.73%) had motor and 7(6.93%) had autonomic neuropathy, 19(18.81%) had PAD, 42(41.58%) had retinopathy and 8(7.9%) had nephropathy.

**Table 1: Demographic, clinical and biochemical Characteristics of DFU patients**

	Healed ulcer	Discharged with unhealed ulcer	Amputation	Total	P value
Number(%)	3(2.97)	64(63.36)	34(33.66)	101	
Gender Male	1(33.33)	45(70.31)	23(67.64)	70(69.3)	0.33
Female	2(66.66)	19(29.68)	11(32.35)	31(30.7)	
Age(years) (mean±SD)	57-60 58.5±2.12	22-77 (57.41±10.68)	38-82 (62.515±10.222)	22-82 (59.05±10.43)	0.00
Education					0.00
Uneducated	02(66.66)	54(84.37)	27(79.41)	83(82.17)	
Under-matric	00(0)	03(4.68)	01(2.94)	04(03.96)	
Matric	00(0)	04(6.25)	02(5.88)	06(05.94)	
Undergraduate	00(0)	00(0)	02(5.88)	02(01.98)	
Graduate	00(0)	03(4.68)	02(5.88)	05(04.95)	
Post graduate	01(33.33)	00(0)	00(0)	01(00.99)	
Duration of diabetes(years)	5-20 (13.33±7.63)	03-30 (10.28±7.53)	0.16-28 (10.58±10.36)	0.03-30 (10.38±7.9)	0.97
Type of Diabetes					0.23
Type 1	00(0)	05(4.95)	00(0)	05(04.95)	
Type 2	03(100)	59(92.18)	34(100)	96(95.04)	
Hypertension	03(100)	18(28.12)	12(35.29)	33(32.67)	0.04
Smoking	00(0)	15(23.437)	10(29.411)	25(24.75)	0.51
-IHD	00(0)	13(20.31)	11(32.35)	24(23.76)	0.33
-PAD	00(0)	13(20.31)	06(17.64)	19(18.81)	0.57
-Neuropathy					0.03
Sensory	02(66.66)	52(81.25)	32(94.11)	86(85.14)	
Motor	01(33.33)	14(21.87)	12(35.29)	27(26.73)	0.34
Autonomic	0(0)	03(04.68)	04(11.76)	07(06.93)	0.33
-Retinopathy	01(33.33)	24(37.50)	17(51.51)	42(41.58)	0.96
-Nephropathy	00(0)	05(7.81)	03(9.09)	08(7.9)	0.54
Serum/Creatinine(mg/dl)	0.1 - 0.6 (0.35±0.25)	0.1-6.8 (1.29±1.05)	0.7-4.2 (1.246±0.82)	0.10-6.80 (1.30±1.05)	0.24
-FBS(mg/dl)	121-324 (122.5±101.5)	69-400 (174.1±83.26)	75-280 (153±58.55)	69-400 168.53±76.79	0.051
-RBS(mg/dl)	118-220 202±54.04	94-564 (255.45±102.716)	117-408 (226.75±83.79)	94-564 248.98±102.25	1.00
-HbA1c(%)	5.9-8.6 (7.16±1.35)	6.0-9.0 (7.23±.81)	6.0-14.0 (8.05±1.55)	6.0-14.0 (7.63±1.23)	0.221

Table No.2: Clinical characteristics of DFU

	Healed N=3	Unhealed N=64	Amputation N=34	Total N=101	P value
Duration of DFU(days)	12-30 (24±10.39)	2-1095 (72.61±179.49)	7-180 (49.82±41.75)	2-1095 (63.86±142.82)	0.56
Pain	01(33.33)	08(12.50)	0(0)	09(8.9)	0.04
Site					
Fore foot	01(33.33)	22(34.37)	19(55.88)	42(41.58)	0.11
Mid foot	01(33.33)	27(42.18)	06(17.64)	34(33.66)	
Hind foot	00(0)	09(14.06)	03(08.82)	12(11.88)	
Whole foot	01(33.33)	06(09.37)	06(17.64)	13(12.87)	
Number					
Single	03(100)	52(81.25)	23(67.64)	78(77.22)	0.32
Multiple	00(0)	12(18.75)	11(32.35)	23(22.77)	
Wagner Grade					
1	01(33.33)	00(0)	00(0)	01(0.99)	0.00
2	02(66.66)	19(29.68)	02(05.88)	23(22.77)	
3	00(0)	45(70.31)	28 (82.35)	73(72.27)	
4	00(0)	00(0)	01(02.94)	01(0.99)	
5	00(0)	00(0)	03(08.82)	03(2.97)	

Regarding ulcer characteristics, mean duration of ulcer at the time of presentation was 63.86±142.82(2-1095) days. Nine(8.9%) patients had painful ulcer, 8(7.9%) had past history of DFU, 78(77.22%) had single ulcer, 1(0.99%) had wagner grade 1, 23(22.77%) had grade 2, 73(72.27%) had grade 3, 1(0.99%) had grade 4 and 3(2.97%) had grade 5 ulcer. Fasting blood glucose was 69-400mg/dl(mean: 168.53±76.79), Random blood glucose 94-564mg/ dl(mean:248.98±102.25), Glycated Hemoglobin (HbA1c) 6-14%(7.63±1.23) and serum creatinine was 0.10-6.80mg/dl(mean:1.30±1.05).

Three (2.97%) patients had healed ulcers at the time of discharge, 64 (63.36%) were discharged on treatment with unhealed ulcer and 34 (33.66%) patients needed amputation.

Table 1 shows demographic, clinical and biochemical characteristics of patients of three groups.

Table 2 shows clinical characteristics DFU of three groups.

## DISCUSSION

Global prevalence of DFU is 6.3%.<sup>4</sup> Diabetes, due to its high prevalence and serious complications, is one of the most important diseases in the world and has always attracted attention of researchers. DFU is one of its dreadful complications as it can sometimes need a major amputation to save life. So it is very important that its risk factors should be identified and treated well in time to save a limb.

In our study we found that majority of patients were males(69.3%) and their mean age was 59±10.43 years comparable with the study of Rodrigues with 62.8% males and mean age of 63.4±14.1years.<sup>5</sup> Ahmad also found mean age of 58.09±11 years and male patients were 80.1%.<sup>6</sup> Old age is associated with increased risk of micro and macrovascular complications and slower immune response to infection. Males are more prone to trauma due to their occupational activities. Unlike our studies, Khan found that 58.7% patients of DFU were females.<sup>7</sup>

We found that 82% of our patients were uneducated. Yekta reported that 57.4% patients were uneducated.<sup>8</sup> Mariam in Ethiopia observed 49.1% and Yazdanpanah in Iran found 36.6% of DFU patients were uneducated.<sup>9,10</sup> So education level of our patients was much lower as compared to other studies. Uneducated people are not aware of foot care essential for diabetic patients. They often walk bare foot and are prone to foot ulcer.

Mean duration of diabetes in our patients was 10.38±7.9years. Musa and Al Rubeaan reported mean durations of 8.5±3.7 and 20.53±7.96 years respectively indicating that DFU was more common in patients with long duration of diabetes.<sup>11,12</sup>

We found hypertension in 32.76% patients. Comparable with our results, Al-Maskari found hypertension in 34.9% cases.<sup>13</sup> But other studies like that by Yekta and Al-Rubeaan reported that hypertension was more common in DFU (46.8 and 56.7% respectively).<sup>8,12</sup> In our study history of IHD was observed in 23.7% cases. Yesil found IHD in 31.3% cases<sup>14</sup> and Rodrigues in 54.4% cases.<sup>5</sup> This indicates that hypertension and IHD are associated with increased prevalence of DFU.

We observed smoking in 24.75% patients. Wang found that 50% of DFU patients were smokers.<sup>15</sup> Smoking is a risk factor for PAD and it also worsens sensory neuropathy.<sup>16</sup>

We found sensory neuropathy in 85.1% cases. Yesil and Wang reported neuropathy in 84.1% and 54.64% cases respectively.<sup>14,15</sup> Loss of sensation and foot deformities predispose foot to trauma and ulceration.

Retinopathy was observed in 41.58% cases. Yekta and Yesil reported retinopathy in 38.2% and 63.2% cases respectively.<sup>8,14</sup> This showed that DFU was associated with microvascular complications of diabetes. All patients with DFU should be referred for ophthalmological examination.

We found that nephropathy(7.9%) was not common among our patients. Ali also found nephropathy in 7% patients.<sup>17</sup> Impaired renal function deceptively leads to better glycemic control and risk of ulcer reduces. But

contrary to our studies Yesil reported nephropathy in 52.6% patients with DFU.<sup>14</sup>

PAD(18.81%) was less common in our study. Yesil observed limb ischemia in 55.9% cases and Khan in 62.8% cases.<sup>14,7</sup> This shows that PAD was more common in other studies.

To determine factors associated with poor outcome, we classified our patients into three groups: healed(2.97%), unhealed(63.36%) and amputation(3.66%) groups. Wang reported healing in 83.6%, non-healing ulcer in 10.21%, and amputation in 6.19% patients.<sup>15</sup> Yesil observed healed ulcer in 48.7%, unhealed ulcer in 14.1% and amputation in 37.1% cases.<sup>14</sup> Healing rate was higher in these studies due to longer follow up and better quality of treatment. Many other studies have been conducted all over the world showing high amputation rates in DFU.<sup>18,19,20</sup> But Bondor in Romania found amputation in only 3.6% cases of DFU.<sup>3</sup> This proves that better management and patient education can reduce high amputation rates in DFU in other parts of the world also.

Mean duration of DFU at the time of presentation was  $24 \pm 10.39$  days in healed,  $72.61 \pm 179.41$  days in unhealed and  $49.82 \pm 41.75$  days in amputation group (p value was 0.56). Wang reported mean duration of  $5.67 \pm 3.03$  weeks in healed,  $34.20 \pm 12.08$  weeks in unhealed and  $15.08 \pm 11.79$  weeks in amputees.<sup>15</sup> Both studies showed that longest duration of presentation was not associated with worst outcome. But Jiang reported that longer duration of presentation is a poor prognostic feature for DFU.<sup>19</sup>

All types of neuropathy, sensory (94.11, 81.25 and 66.66%), motor (35.29, 21.87 and 33.33%) and autonomic (11.76, 4.68 and 0%) were more common in amputation group than in unhealed and healed ulcer groups respectively. This means that neuropathy is an important risk factor for DFU as well as amputation. This is statistically significant as p value is 0.03 for sensory neuropathy. Wang also found that neuropathy is more common in patients who had amputation.<sup>15</sup> Boyko also found that neuropathy influences diabetic foot ulcer outcome.<sup>21</sup> Painless neuropathic ulcers remain unnoticed for a long time and present late. But unlike our observation, Yesil found highest percentage of neuropathy in healed(89.6%) followed by unhealed(82.7%) and amputation(77.5%) groups.<sup>14</sup>

We found that nephropathy was 0% in healed, 7.81% in unhealed and 9.09% in amputation group. So nephropathy although uncommon in our study, was more frequent in amputees. But this observation was not statistically significant (p value 0.54). Ali found that nephropathy was not frequent in amputees(3.30% versus 3.77%).<sup>17</sup> Yesil found nephropathy in 52.9% in healed, 50.6% in unhealed and 53.1% in amputation group.<sup>14</sup> Wang reported that nephropathy is associated with increased risk of amputation.<sup>15</sup>

We observed retinopathy in 33.33% cases in healed, 37.50% in unhealed and 51.51% in amputation group (p value 0.96). Yesil reported that retinopathy was more common in his patients(62.1, 64.2 and 64.3% in healed,

unhealed and amputation groups respectively).<sup>14</sup> Yekta found that retinopathy was associated with poor outcome. (68.8% in amputation and 19.4% in non-amputation groups).<sup>8</sup> Visual impairment can seriously affect outcome of DFU.

We found PAD in 0% in healed, 20.31% in unhealed and 17.64% cases in amputation group (p value 0.57). But Yesil found that limb ischemia was more common in patients with amputation (36.1% healed, 59.3% unhealed and 80.8% in amputation group).<sup>14</sup> Xu B also found that PAD is more common in amputation as compared to non amputation group (68.11% versus 25.04%).<sup>22</sup> Similar to our observation Musa in Saudi Arabia also found that ischemic ulcer is less common in amputation group.<sup>11</sup> So we conclude that PAD is a less common predictor for amputation in Pakistan and some other countries like Saudi Arabia.

In our study HbA1c was highest in amputees ( $8.05 \pm 1.55$ ). This indicated that poor glycemic control increases risk of amputation but this was not statistically significant (p value is 0.22). Al-Rubeaan also found high HbA1c in patients who underwent amputation.<sup>12</sup> But Ali did not find association between poor glycemic control and amputation.<sup>17</sup> Musa unusually found low HbA1c in amputation group considering coexistent renal impairment as underlying cause.<sup>11</sup>

We found smoking in 29.4% patients who underwent amputation as compared 23.4% who did not. This revealed that smoking increases risk of amputation but p value was 0.51. Yesil found smoking almost equally in amputation(45.5%) and unhealed groups(45.7%) while in healed group it was less common(36.1%).<sup>14</sup> Sayiner also observed that smoking increases risk of amputation in DFU.<sup>18</sup>

Our study showed that Wagner grade was significantly high in amputation group (grade 3- 82.35%) as compared to unhealed (grade 3-70.31%) and cured (grade 3- 0%) groups. It was found to be statistically significant (p value 0.00). Yesil observed that 53.1% patients who underwent amputation had grade 4 ulcer.<sup>14</sup> Wang and Jiang also observed that amputation was associated with higher wagner grade.<sup>15,19</sup> This supports that wound state according to wagner grade is a predictor for amputation.

## CONCLUSION

We found that DFU is more common in old, uneducated males with long duration of Diabetes. Hypertension, IHD, neuropathy, retinopathy and smoking were associated with increased prevalence of DFU. We observed very high amputation and low healing rates which is an alarming situation. Sensory neuropathy, wagner grade (with p values  $< 0.05$ ), poor glycemic control and smoking (p values  $> 0.05$ ), and were associated with poor outcome. PAD and nephropathy were relatively less common in our patients. All these co-morbid should be managed aggressively along with patient education programmes

about foot care for prevention of DFU. Early referral to a tertiary care hospital for aggressive wound care and adequate glycemic control will prevent amputation. More prospective studies are needed to confirm our findings with larger sample size and longer follow up.

#### Author's Contribution:

Concept & Design of Study: Zahara Nazish  
 Drafting: Muhammad Younas Khan  
 Data Analysis: Fatima Tuz Zahara  
 Revisiting Critically: Zahara Nazish, Muhammad Younas  
 Final Approval of version: Zahara Nazish

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## REFERENCES

1. Wild S, Roglic G, Green A, Sicree R, King H. Global Prevalence of Diabetes: Estimates for the year 2000 and projections for 2030. *Diabetes care* 2004;27(5):1047-53.
2. Aamir AH, Ul-Haq Z, Mahar SA, Qureshi FM, Ahmad I, Jawa A, et al. Diabetes Prevalence Survey of Pakistan(DPS-PAK): prevalence of type 2 diabetes mellitus and prediabetes using HbA1c: a population based survey from Pakistan. *BMJ Open* 2019;9(2):e025300.
3. Bondor CI, Veresiu IA, Florea B, Vinik EJ, Vinik AI, Gavan NA. Epidemiology of Diabetic Foot Ulcers and Amputations in Romania: Results of a Cross-Sectional Quality of Life Questionnaire Based Survey. *J Diabetes Res* 2016;2016:5439521.
4. Zhang P, Lu J, Jing Y, Tang S, Zhu D, Bi Y. Global epidemiology of diabetic foot ulceration: a systematic review and meta-analysis. *Ann Med* 2017;49(2):106-116.
5. Rodrigues BT, Vangaveti VN, Malabu UH. Prevalence and Risk Factors for Diabetic Lower Limb Amputation: A Clinic-Based Case Control Study. *J Diabet Res* 2016;2016(4):1-7.
6. Ahmad W, Khan IA, Ghaffar S, Al-Swailmi FK, Khan I. Risk factors for diabetic foot ulcer. *J Ayub Med Coll Abbottabad* 2013;25(1-2):16-18.
7. Khan MIH, Azhar U, Zubair F, Khan ZA. Can we link foot ulcer with risk factors in diabetics? A study in a tertiary care hospital. *Pak J Med Sci* 2018; 34(6): 1375-1380.
8. Yekta Z, Pourali R, Nezhadrahim R, Ravanyar L, Ghasemi-Rad M. Clinical and behavioural factors associated with management outcome in hospitalized patients with diabetic foot ulcer. *Diabetes Metab Syndr Obes* 2011;4:371-75.
9. Mariam TG, Alemayehu A, TesfayeE, Mequannt W, Temesgen K, Yetwale F, et al Prevalence of diabetic foot ulcer and associated factors among adult diabetic patients who attend the Diabetic follow-up clinic at the university of Gondar Referral Hospital, North West Ethiopia 2016. *J Diabetes Res* 2017;1-8.
10. Yazdanpanah L, Shahbazian H, Nazari I, Arti HR, Ahmadi F, Mohammadianinejad SE, et al. Incidence and risk factors of diabetic foot ulcer: A population-based diabetic foot cohort (ADFC study). *Int J of Endocrinol* 2018;2018:1-9.
11. Musa IR, Ahmad MON, Sabir EI, Alsheneber IF, Ibrahim EME, Mohamed GB, et al. Factors associated with amputation among patients with diabetic foot ulcers in a Saudi population. *BMC Res Notes* 2018; 11(1):260.
12. Al-Rubeaan K, Al Derwish M, Ouizi S, Youssef AM, Subhani SN, Ibrahim HM, et al. Diabetic foot complications and their risk factors from a large retrospective cohort study. *PLoS One* 2015; 10(5):e0124446.
13. Al-Maskari F, El-Sadig M. Prevalence of risk factors for diabetic foot complications. *BMC Fam Pract* 2007;8(1):59.
14. Yesil S, Akinci B, Yener S, Bayraktar F, Karabay O, Havitcioglu H, et al. Predictors of amputation in diabetics with foot ulcer: Single centre experience in a large Turkish cohort. *Hormones* 2009, 8(4):286-295.
15. Wang A, Sun X, Wang W, Jiang K. A study of prognostic factors in Chinese patients with diabetic foot ulcers. *Diabet Foot Ankle* 2014;5(1):1-5.
16. Xia N, Morteza A, Yang F, Cao H, Wang A. Review of the role of cigarette smoking in diabetic foot. *J Diabetes Investig* 2019;10(2):202-15.
17. Ali SM, Basit A, Fawwad A, Ahmedani MY, Miyani Z, Malik RA. Presentation and outcome of diabetic foot at a tertiary care unit. *Pak J Med Sci* 2008; 24(5):651-56.
18. Sayiner ZA, Can FI, Akarsu E. Patients' clinical characteristics and predictors for diabetic foot amputation. *Prim care Diabetes* 2019;13(3):247-251.
19. Jiang Y, Ran X, Jia L, Yang C, Wang P, Ma J, et al. Epidemiology of type 2 diabetic foot problems and predictive factors for amputation in China. *Int J Low Extrem Wounds* 2015;14(1):19-27.
20. Mehmood K, Akhtar ST, Talib A, Abbasi B, Siraj-ul-Salekeen, Naqvi IH. Clinical profile and management outcome of diabetic foot ulcers in a tertiary care hospital. *J Coll Physicians Surg Pak* 2008;18(7):408-12.
21. Boyko EJ, Ahroni JH, Stensel V, Forsberg RC, Davignon DR, Smith DG. A prospective study of risk factors for diabetic foot ulcer. *The Seattle Diabetic foot study. Diabetes Care* 1999; 22(7):1036-42.
22. Xu B, Yang CZ, Wu SB, Zhang D, Wang LN, Xiao L, et al. Risk factors for lower extremity amputation in patients with diabetic foot. *Zhonghua Nei Ke Za Zhi* 2017;56(1):24-2.